Space Weather Technical Forecast

Issued on Thursday 9 January 2025 at 12:50 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares. Active electron fluence likely Days 1-2 (09-10 Jan).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate activity during the last 24 hours with a flare peaking at M1.1, observed from AR3947 at 09/0026UTC. There are now ten sunspot regions on the visible disc. The only region currently of note is AR3947 in the northwest, which has been responsible for the majority of any recent activity. With the recovery of some of the high resolution SDO imagery, it can now be seen that this region does not contain a delta spot, but does have some weak complexity. The other regions on the disc remain small and simple.

No Earth-directed CMEs were observed, although the recent lack of SOHO coronagraph imagery combined with large gaps in STEREO coronagraph imagery mean this is more uncertain than usual.

Solar Wind / Geomagnetic Activity: Solar winds declined to background levels, then possibly followed by a weak HSS onset. Wind speeds were initially slightly elevated at 450km/s but declined to background around 380 km/s. Density was average or below. The Interplanetary Magnetic Field, Bt, was mostly weak, rising a little after 09/0800UTC to peak at 8nT. The north-south component, Bz, was weakly variable, but became more southward directed after 09/0845 UTC, down to -8nT. Phi angle was positive (away from the Sun), becoming variable after 09/0900 UTC. Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES-18 was at background levels. High energy electron flux (greater than 2MeV) at GOES16 has been diurnally high, peaking at 1550 pfu at 08/1450 UTC. The associated 24 hour fluence was just under the Active threshold on a slight declining trend, reading 6.78e7 integrated pfu at 09/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate with an ongoing chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are thought to be no Earth-directed CMEs, although this is more uncertain than usual due to lack of coronagraph imagery. Solar winds are showing signs of some weak disturbance, perhaps an early onset of the high speed stream from CH07/+. Wind speeds from this feature are likely to be not much above 400 km/s.

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Geomagnetic activity is expected to be mostly Quiet to Unsettled, perhaps with the odd Active interval Day 1 or Day 2 (09-10 Jan) with any high speed stream influence.

Energetic Particles / Solar Radiation: GOES18 high energy proton flux is expected to remain near background levels, with only a slight chance of rising in response to any notable flares. GOES 16 high energy electron flux is forecast to continue at moderate to high levels. The associated 24 hour fluence is likely to rise above the Active threshold on Days 1-2 (09-10 Jan), perhaps with a slow declining trend thereafter.

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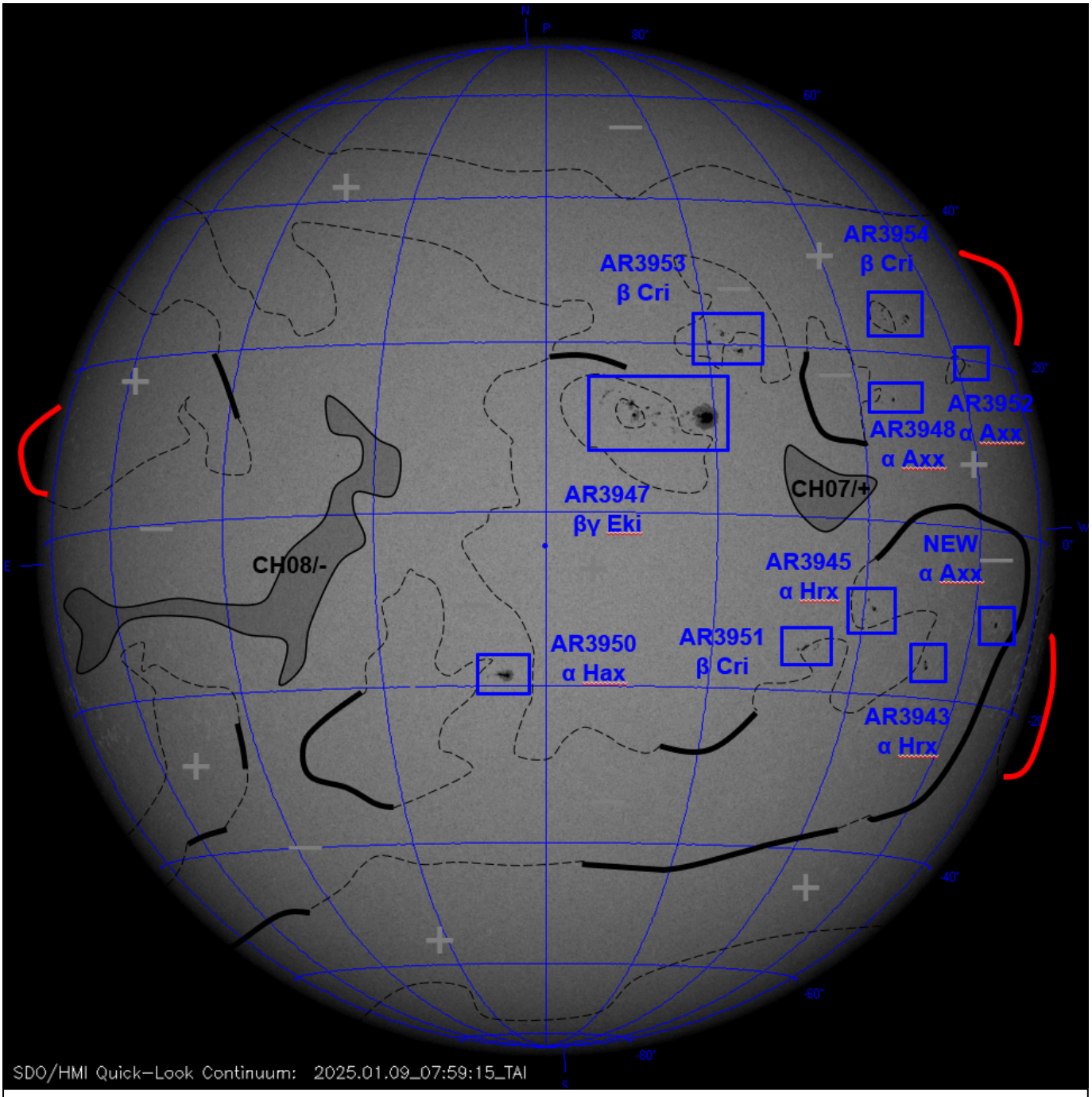
Figure 1: Solar synoptic map, valid at 09/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are thought to be no Earth-directed CMEs, although the recent lack of SOHO coronagraph imagery combined with large gaps in STEREO coronagraph imagery mean this is more uncertain than usual. Solar winds recently declined to background levels after the high speed stream from CH05/+. However, solar winds are showing signs of some weak disturbance, likely an early onset of the high speed stream from CH07/+. This feature is small, and reduced from the previous rotation where it gave 400-450 km/s. Therefore, wind speeds this time around are likely to be not much above 400 km/s.

Geomagnetic activity is expected to be mostly Quiet to Unsettled, perhaps with the odd Active interval Day 1 or Day 2 (09-10 Jan) with any high speed stream influence.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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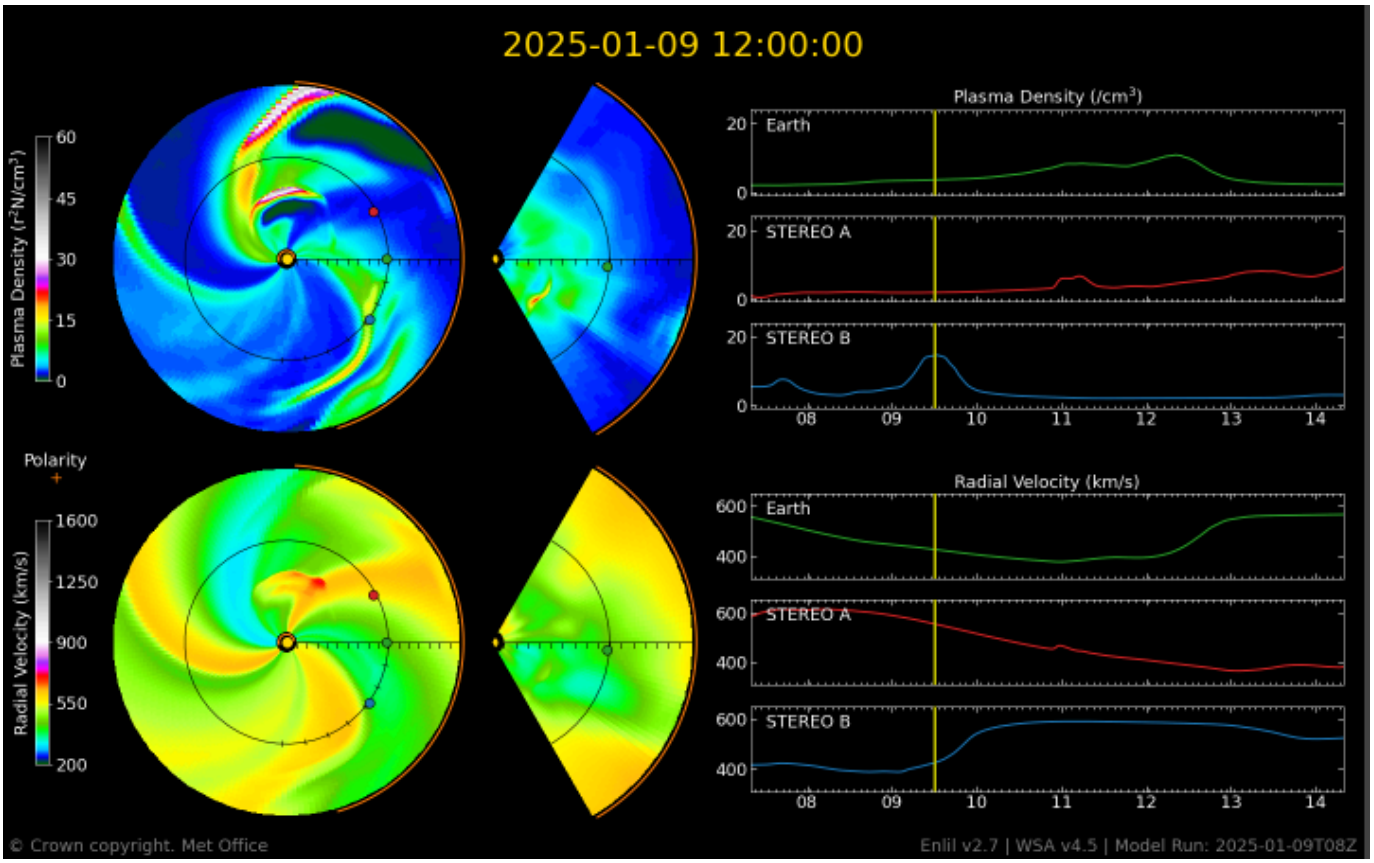
Figure 2: MOSWOC Enlil, showing a general decline in wind speeds which may not be capturing any weak HSS from CH07. The increase towards the end of the period is likely related to CH08, and is considered to be occurring too soon in Enlil.



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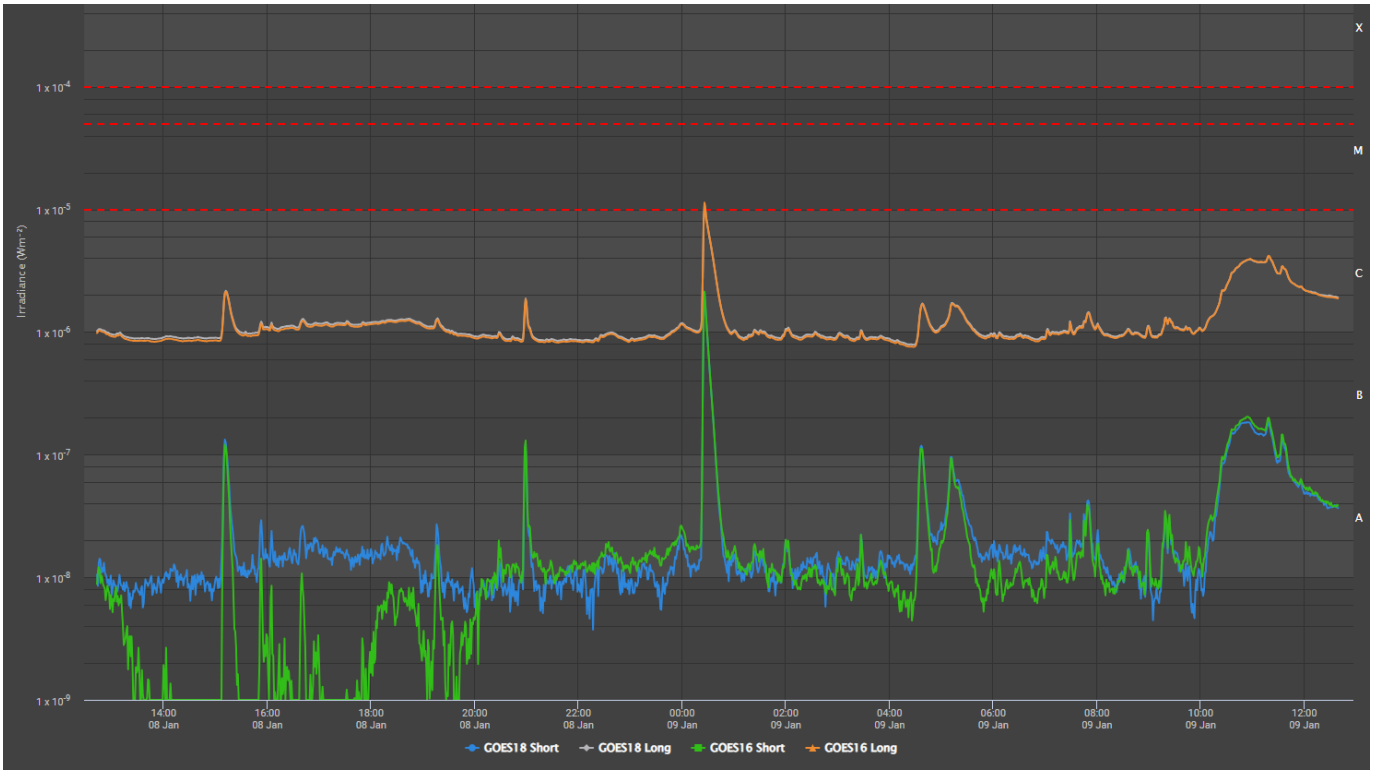
Radio Blackouts - X-Ray Flares

Moderate activity during the last 24 hours with a flare peaking at M1.1, observed from AR3947 at 09/0026UTC. There remains a chance of further isolated M-class flares, primarily from AR3947.

There are now ten sunspot regions on the visible disc with AR3944 no longer visible on the west limb, but a new region developing in the southwest and AR3951 re-developing. The only region currently of note is AR3947, which has been responsible for the majority of any recent activity. With the recovery of some of the high resolution SDO imagery, it can now be seen that this region does not contain a delta spot, but does have some weak complexity. The other regions on the disc remain small and simple.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	50	50	50	50
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 3: X-ray flux at GOES16 and 18, showing one low level M-flare in the last 24 hours.



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux has returned to background levels, having eased after the recent enhancement. The source of this enhancement, AR3939, is now onto the far-side, with a decreasing potential to erupt high energy protons that can be observed at Earth. However a slight chance of further enhancement is maintained due to AR3947 which is now in the western hemisphere. Furthermore, there are a number of filaments currently on the disc, and it is not impossible that a large eruption from any of these could result in Earth-directed high energy protons.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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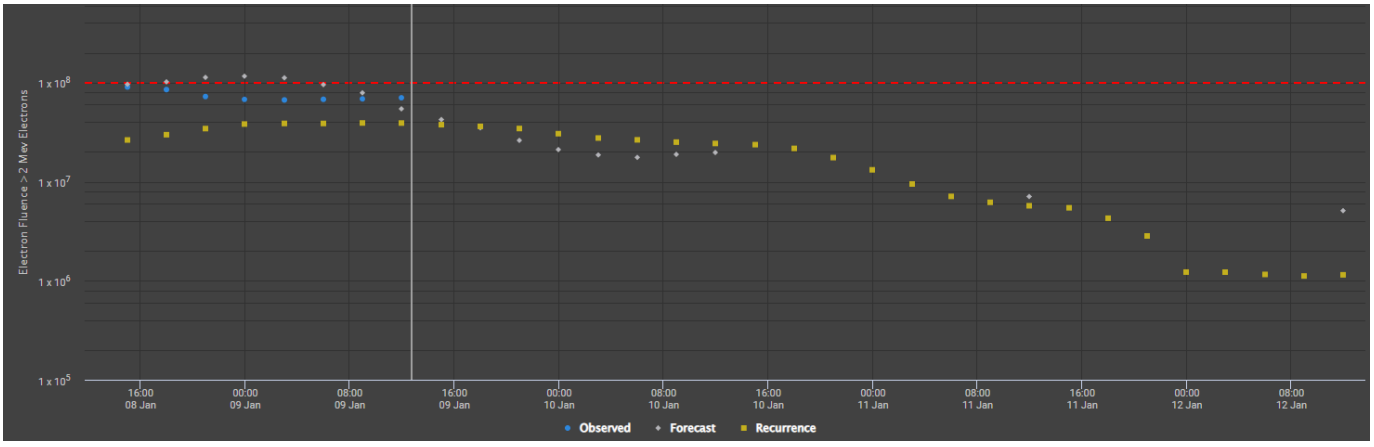
High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been varying between moderate and diurnally high values over the last few days. This is as a result of the recent fast wind enhancement from CH05. Now solar wind speeds have eased, there is the possibility of a further increase as the radiation belts fully expand back to incorporate GEO. However, there is some uncertainty as to the strength of any high speed stream from CH07, which may be starting to show an influence at L1. Whilst this could compress the radiation belts once again, it is considered likely to be weak and may have little influence. Overall, it is probable that electron flux values will remain diurnally high, possibly with an increase in the diurnal maximum on Day 1 (09 Jan).

Fluence is currently near the Active threshold, albeit with a slight declining trend. This may rise above the Active threshold on Day 1 or Day 2 (09-10 Jan), perhaps with a slow declining trend thereafter. REFM is suggesting a fairly sharp decline in values, and is likely to be declining too fast and too soon.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	70	60	50	40
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM showing a decline in fluence which may be too fast and too soon.



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